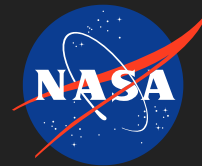


# Design Concepts for Low Aspect Ratio High Pressure Turbines for High Bypass Ratio Turbofans, Phase II

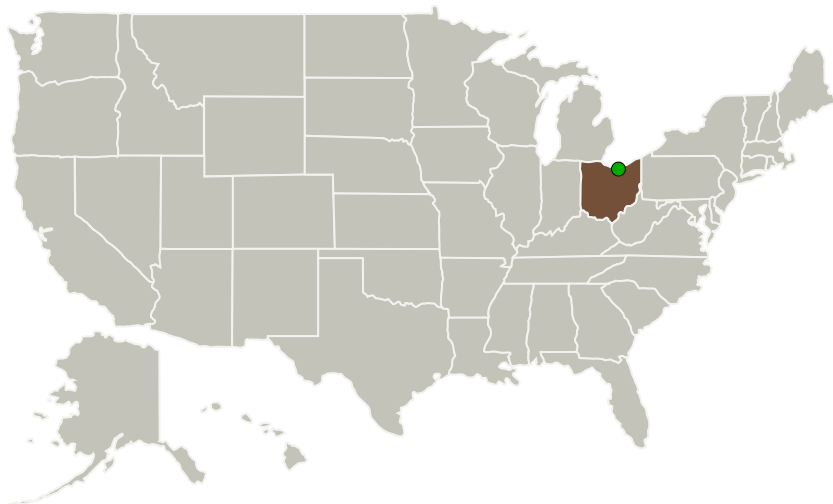
Completed Technology Project (2017 - 2020)



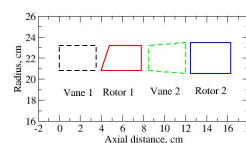
## Project Introduction

The performance gains and weight reductions from using Ceramic Matrix Composite (CMC) turbine blades in both the High Pressure Turbine (HPT) and Low Pressure Turbine (LPT) will be determined. Shrouding HPT rotor blades becomes feasible when low density CMC materials replace current metallic HPT rotor blades. The proposal has two components. The first is to identify stage efficiency improvements and verify structural feasibility of shrouding a low aspect ratio HPT rotor blade designed to use CMC blades. The second is to perform similar analyses for metallic and CMC LPT blades. HPT stage efficiency gains will be determined using CFD analyses for shrouded and unshrouded HPT turbines as a function of clearance and stage reaction. The increase in blade component stresses due to the presence of a shroud, and the stresses in the shroud itself will be determined from structural analyses. Comparing analytic results with available structural data for shrouded metallic LPT blades will increase confidence in the structural predictions of shrouded HPT blades. The reduction in engine weight from using CMC blades in the LPT will be determined. Current metallic LPT blades are shrouded, so that no significant stage aerodynamic efficiency gain is anticipated from replacing metallic LPT blades with CMC blades. In a geared turbine fewer LPT stages, or greater work per stage, may be achieved from using CMC rotor blades.

## Primary U.S. Work Locations and Key Partners



Low aspect ratio HPT vanes and rotor blades



Design Concepts for Low Aspect Ratio High Pressure Turbines for High Bypass Ratio Turbofans, Phase II

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# Design Concepts for Low Aspect Ratio High Pressure Turbines for High Bypass Ratio Turbofans, Phase II

Completed Technology Project (2017 - 2020)



Organizations Performing Work	Role	Type	Location
N&R Engineering	Lead Organization	Industry Small Disadvantaged Business (SDB)	Parma Heights, Ohio
● Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

## Primary U.S. Work Locations

Ohio

## Project Transitions



**June 2017:** Project Start

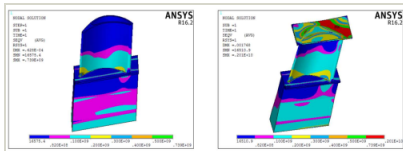


**May 2020:** Closed out

### Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/141137>)

## Images



### Briefing Chart Image

Design Concepts for Low Aspect Ratio High Pressure Turbines for High Bypass Ratio Turbofans, Phase II Briefing Chart Image (<https://techport.nasa.gov/image/133223>)

## Organizational Responsibility

### Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

### Lead Organization:

N&R Engineering

### Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

### Program Director:

Jason L Kessler

### Program Manager:

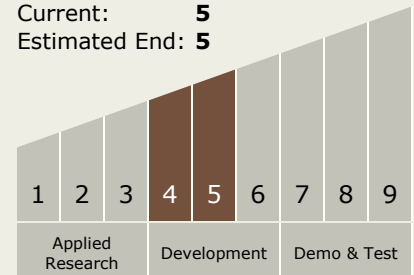
Carlos Torrez

### Principal Investigator:

Robert J Boyle

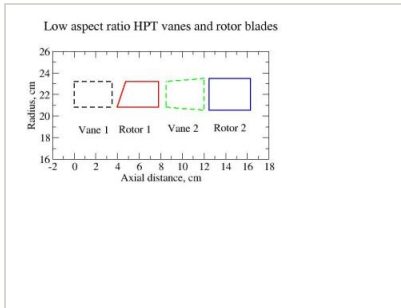
## Technology Maturity (TRL)

Start: **4**  
Current: **5**  
Estimated End: **5**



# Design Concepts for Low Aspect Ratio High Pressure Turbines for High Bypass Ratio Turbofans, Phase II

Completed Technology Project (2017 - 2020)



## Final Summary Chart Image

Design Concepts for Low Aspect Ratio High Pressure Turbines for High Bypass Ratio Turbofans, Phase II

(<https://techport.nasa.gov/image/135343>)

## Technology Areas

### Primary:

- TX01 Propulsion Systems
  - └ TX01.3 Aero Propulsion
    - └ TX01.3.1 Integrated Systems and Ancillary Technologies

## Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System